

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : D02G 3/04, D01F 6/46, 6/90, 8/06, 8/12, E01C 13/08		A1	(11) International Publication Number: WO 99/04074 (43) International Publication Date: 28 January 1999 (28.01.99)
(21) International Application Number: PCT/NL98/00413 (22) International Filing Date: 16 July 1998 (16.07.98) (30) Priority Data: 1006606 17 July 1997 (17.07.97) NL (71) Applicant (for all designated States except US): TAPUTFAB- RIEK H. DESSEAUX N.V. [NL/NL]; Postbus 6, NL-5340 BD Oss (NL). (72) Inventor; and (75) Inventor/Applicant (for US only): GEERTS, Jan, Frans, Marie [BE/BE]; Juniorlaan 72, B-2811 Leest (BE). (74) Agent: VAN KAN, J., J., H.; Algemeen Octrooibureau, World Trade Center, Pastoor Petersstraat 160, NL-5612 LV Eindhoven (NL).			(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>In English translation (filed in Dutch).</i>
(54) Title: A YARN FOR ARTIFICIAL GRASS, A METHOD OF MANUFACTURING SAID YARN AND A FIELD OF ARTIFICIAL GRASS IN WHICH SAID YARN IS INCORPORATED			
(57) Abstract The invention relates to a yarn containing polyamide for producing artificial grass, wherein said yarn, in addition to polyamide, also contains a polyolefin compound selected from the group consisting of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene. The invention furthermore relates to a method of manufacturing such a yarn, and also to a field of artificial grass made from such yarns.			

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

A yarn for artificial grass, a method of manufacturing said yarn and a field of artificial grass in which said yarn is incorporated.

5 The invention relates to a yarn containing polyamide for producing artificial grass. The invention furthermore relates to a method of manufacturing said yarn and to a field of artificial grass in which said yarn is incorporated.

10 Such a yarn for a field of artificial grass is known from Japanese patent publication JP 7048778A. The field of artificial grass is obtained by intertwinning polyamide fibre and PE fibre in a base layer. More in particular, the method comprises the provision in a base layer, in a pile length of 25 mm, of a yarn by twisting split yarn made of 5000d polyamide and split yarn made of 5000d high density PE.

15 Such a yarn is also known from Japanese patent publication JP 09119036A, wherein a yarn for artificial turf pile is formed by melt-spinning a polyamide resin composition comprising 70 - 99 % by weight of a polyamide resin and 1 - 30 % by weight of a polyethylene resin.

20 From EP-A-0 648 868 a yarn is furthermore known which is used for making artificial grass, which yarn is manufactured of polypropylene or of a block copolymer of polypropylene and polyethylene.

25 It has now become apparent that the properties of yarn for artificial grass, in particular its wear-resistance, flexibility and processibility, can be improved by manufacturing the artificial grass of a specified combination of polymers, and consequently the yarn according to the invention is characterized in that the yarn, in addition to polyamide, also contains a polyolefin compound selected from the group consisting of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene.

30 In particular it is preferred for the yarn to contain 20 - 80 % by weight of polypropylene and 80 - 20 % by weight of polyamide. The use of this specific mixture of polypropylene and polyamide leads to improved mechanical properties of the artificial grass, which mechanical properties are considerably better than those of polypropylene and polyamide individually.

35

In a preferred embodiment of the yarn according to the present invention, a block copolymer of polypropylene and polyethylene is used. A particularly suitable block copolymer is the polypropylene/-polyethylene block copolymer as described in European patent application
5 No. 0 359 321, which document may be considered to be incorporated herein, which block copolymer is marketed by Solvay, Belgium with a melt flow index of about 4. Such a preferred yarn is preferably composed of 20 - 80 % by weight of block copolymer of polypropylene and polyethylene, and 20 - 80 % by weight of polyamide.

10 In specified embodiments it is also possible, however, to produce a yarn which, in addition to polyamide, contains the polymer LLDPE (Linear Low Density Polyethylene). Such a yarn is preferably composed of 20 - 80 % by weight of LLDPE and 20 - 80 % by weight of polyamide. Although a polyamide resin composition of polyamide resin and a poly-
15 ethylene composition containing 50 - 100 % by weight of LLDPE and 0 - 50 % by weight of a maleic acid anhydride modified polyethylene resin is known from Japanese patent publication JP 09119036A, it should be understood that the present composition of 20 - 80 % by weight of LLDPE and 20 - 80 % by weight of polyamide is essentially different from the composition which
20 is mentioned in said Japanese patent publication.

From JP-A-5,171,613 it is known to manufacture artificial grass from various polymers. Said Japanese patent publication mentions a large number of polymers, among which polypropylene and Nylon. It does not describe a yarn which is made from the present combination
25 of polypropylene and/or polyethylene and polyamide, however. Nor does said Japanese patent publication disclose a method of manufacturing the yarn as used in accordance with the invention.

JP-A-3,279,419 discloses a fibre which consists of Nylon which is mixed with polypropylene. Said fibre has been used for making
30 clothes. Said Japanese patent publication does not describe the use of such a mixture of polymers for manufacturing artificial grass.

US patent No. 5,597,650 discloses a carpet yarn having special properties as regards flame retardation and resistance to stains. Said yarn consists of a polyolefin matrix, preferably polypropylene, in
35 which smaller polyamide fibrils are embedded. Said US patent does not describe the use of such a yarn for manufacturing artificial grass.

According to the method which is used in particular for producing yarns which are used for manufacturing artificial grass, the polymer is extruded to form monofilaments, which are subsequently processed into bands, with several bands being twisted to form a yarn, and possibly with several yarns being twined to form a composite yarn. This method is characterized in that monofilaments are extruded from one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene, and that monofilaments are extruded from polyamide, or in that monofilaments are extruded from a mixture of one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene on the one hand and polyamide on the other hand. Furthermore it is preferred to process in particular the monofilaments of the block copolymer of polyethylene and polypropylene into a first yarn containing the block copolymer of polyethylene and polypropylene, and to process the monofilaments of polyamide into a second yarn containing polyamide, after which the two yarns are joined to form a composite yarn. Then the artificial grass is manufactured of said composite yarn. In specified embodiments, however, it is preferred to use a yarn of the block copolymer of polypropylene and polyethylene on the one hand and a yarn of polyamide on the other hand as separate yarns for producing a field of artificial grass. Experiments have shown that fields of artificial grass produced in this manner exhibit better mechanical properties than fields of artificial grass according to the prior art as described above. Such a method of producing monofilaments is described in European patent No. 0 648 868, which document may be considered to be incorporated herein.

Furthermore it is preferred to use co-extrusion in manufacturing the yarn according to the present invention. According to such a method, the core is built up of one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene, and the cladding is built up of polyamide. Under certain circumstances it is preferred to exchange the aforesaid core and cladding materials, so that a core of polyamide is obtained.

The present invention is not limited to the use of monofilaments, and in a special embodiment it is preferred to use one of the yarns from the group of fibrillated yarn of the block copolymer of polyethylene and polypropylene, fibrillated yarn of HDPE, fibrillated yarn

of LLDPE, fibrillated yarn of polypropylene on the one hand and a yarn of fibrillated polyamide yarn on the other hand. The method of producing fibrillated yarn is described in European patent application No. 0 263 566, which application may be considered to be incorporated herein. Thus, in
5 a special embodiment of the method according to the present invention a foil is made from a polymer which, in addition to polyamide, also contains a polyolefin compound selected from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene, which foil is cut into bands, with several bands being twisted to form a yarn, and possibly
10 with several yarns being twined to form a composite yarn. According to such a method it is also possible on the one hand to make a foil from one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene and on the other hand to make a foil from polyamide, after which the bands obtained from said two foils
15 may be processed to form said composite yarn. A combination of monofilaments and fibrillated yarns, preferably monofilaments of polyamide and fibrillated yarn of the block copolymer of polypropylene and polyethylene, is also suitable for manufacturing the composite yarn.

The invention will be explained in more detail hereafter
20 by means of the following examples.

Example 1

Monofilaments were obtained by extrusion of the block copolymer of polyethylene and polypropylene on the one hand and by extrusion of polyamide on the other hand, and after stretching said
25 monofilaments, bands were obtained. A method as indicated in example 1 of EP-A-0 648 868 was thereby used for the block copolymer. The bands were processed to form a yarn, thus producing the block copolymer of polyethylene and polypropylene yarn consisting of four non-twisted bands each having a yarn number of 1100 dtex on the one hand and a polyamide yarn
30 consisting of non-twisted bands each having a yarn number of 666 dtex on the other hand. Said two yarn types were twined to form a composite yarn having a yarn number of 8400 dtex. Said composite yarn was then knitted and fixed so as to obtain a teasing effect, after which the teased composite yarn was used for obtaining a carpet for artificial grass.

35 To this end the yarn was tufted with 300 stitches per running metre, and a pile height of 12.5 mm, resulting in a pile insert weight of 1750 g/m².

The carpet thus obtained was subjected to various tests in order to determine the mechanical properties, such as the tretrad test for determining the fibrillation, the Taber test for determining the weight loss and the Leroux test for determining the sliding properties.

The data that were obtained are shown in table A.

Table A

	Block copolymer of polypropylene and polyethylene	Polyamide	Composite yarn of polyamide and block copolymer of polypropylene and polyethylene
tretrad	post-fibrillation	no post-fibrillation	no post-fibrillation
Taber (g/m ²) loss			
2000 t	0.38	0.56	0.32
5000 t	0.93	1.49	0.76
sliding Leroux			
dry	0.790	0.760	0.772
wet	0.537	0.440	0.390

The data in this table show that the artificial grass made from the combination of the block copolymer of polyethylene and polypropylene and polyamide did not exhibit any post-fibrillation, so that a much better result is obtained than with artificial grass made from a polypropylene-containing polymer, that the weight loss results as measured by means of the Taber test are much better than with the artificial grass made from the block copolymer of polyethylene and polyethylene and with the artificial grass made from polyamide, that the sliding results as measured by means of the Leroux test are much better in wet conditions, and that the sliding results of artificial grass made from polyamide are slightly better only in dry conditions. Furthermore it has become apparent that burn tests in accordance with BS 4790 show a low value for the artificial grass according to the invention, which value is comparable

with that of artificial grass made from polyamide, but which is better than that of artificial grass made from polypropylene-containing polymer.

Summarizing the above it can be stated, therefore, that the results obtained with the artificial grass according to the invention are better than the results that could be expected with artificial grass of polyamide or with artificial grass of polypropylene-containing polymer. This shows that a synergetic effect is obtained with the combination of starting materials according to the invention.

Example 2

The artificial grass was manufactured in the same manner as in Example 1. A field of artificial grass scattered in with sand was composed, to which end the yarn was tufted with 140 stitches per running metre and a pile height of 34 mm, as a result of which a pile insert weight of 970 g/m² was obtained. The carpet thus obtained was subjected to tests comparable with the tests of Example 1. It has become apparent thereby that, also in the case of a field of artificial grass scattered in with sand, the mechanical properties of the yarn composed of the block copolymer of polyethylene and polypropylene and polyamide were much better than those of yarns for fields of artificial grass which were made from polypropylene and from polyamide.

Example 3

Monofilaments were obtained by extrusion of the block copolymer of polyethylene and polypropylene on the one hand and by extrusion of polyamide on the other hand, and after stretching said monofilaments, bands were obtained. A method as indicated in example 1 of EP-A-0 648 868 was thereby used for the block copolymer, so as to obtain a block copolymer having a yarn number of 8800 dtex consisting of 8 bands, each having a yarn number of 1100 dtex. Then a polyamide having a yarn number of 4000 dtex, which consisted of 6 bands, was twined with a polyamide having a yarn number of 4000 dtex, which consisted of 6 bands, to form a yarn having a yarn number of 8000 dtex, which consisted of 12 bands. In order to be subjected to a tufting operation, the block copolymer yarn was preferably threaded on the uneven positions on the creel of the tufting machines, whilst the polyamid yarn was threaded on the even positions. It is also possible, however, to use other position settings. The carpet for artificial grass, which was built up of separate yarns of block copolymer and polyamide, was tufted with 310 stitches per running

metre, and a pile height of 12.5 mm, resulting in a pile insert weight of 1750 g/m².

5 The carpet thus obtained was subjected to tests comparable with the tests of Example 1. It has become apparent thereby that, also in the case of a field of artificial grass, whether or not scattered in with sand, the mechanical properties of the field of artificial grass made from the block copolymer of polyethylene and polypropylene and polyamide were much better than those of fields of artificial grass made from polypropylene and from polyamide.

CLAIMS.

1. A yarn containing polyamide for producing artificial grass, characterized in that said yarn, in addition to polyamide, also
5 contains a polyolefin compound selected from the group consisting of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene.
2. A yarn according to claim 1, characterized in that said
10 yarn contains 20 - 80 % by weight of polypropylene and 20 - 80 % by weight of polyamide.
3. A yarn according to claim 1, characterized in that said
yarn contains 20 - 80 % by weight of block copolymer of polypropylene and polyethylene and 20 - 80 % by weight of polyamide.
4. A yarn according to claim 1, characterized in that said
15 yarn contains 20 - 80 % by weight of LLDPE and 20 - 80 % by weight of polyamide.
5. A method of manufacturing a yarn according to claims
20 1 - 4 by extruding polymer to form monofilaments, which are subsequently processed into bands, with several bands being twisted to form a yarn, and possibly with several yarns being twined to form a composite yarn, characterized in that monofilaments are extruded from one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene, and from polyamide, or in that
25 monofilaments are extruded from a mixture of one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene on the one hand and polyamide on the other hand.
6. A method according to claim 5, characterized in that
a yarn is manufactured from the block copolymer of polypropylene and polyethylene, and that a yarn is manufactured from polyamide, whereupon
30 said composite yarn is made from the two yarns of the block copolymer of polyethylene/polypropylene and polyamide, after which artificial grass fibres are made from said composite yarn.
7. A method of manufacturing a yarn according to claims
35 1 - 4 by starting from a foil which is cut into bands, with several bands being twisted to form a yarn, and possibly with several yarns being twined to form a composite yarn, characterized in that a foil is made from a polymer which, in addition to polyamide, contains a polyolefin compound

selected from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene, or in that on the one hand a foil is made from one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene and in that on the other hand a foil is made from polyamide, after which the bands obtained from said two foils may be processed to form said composite yarn.

8. A method according to claim 7, characterized in that a yarn is manufactured from the block copolymer of polypropylene and polyethylene, and that a yarn is manufactured from polyamide, whereupon artificial grass fibres are made from the composite yarn obtained from said two yarns.

9. A method of manufacturing yarns according to claims 1 - 4, characterized in that said yarn is obtained by co-extrusion, wherein the cladding consists of polyamide, and wherein the core consists of one of the polyolefins from the group of polypropylene, LLDPE and a block copolymer of polypropylene and polyethylene.

10. A field of artificial grass made from artificial grass fibres, characterized in that said artificial grass fibres are manufactured from a yarn as defined in claims 1 - 4.

11. A field of artificial grass made from artificial grass fibres, characterized in that said artificial grass fibres are manufactured in accordance with a method as defined in claims 5 - 9.

12. A field of artificial grass according to claims 10 - 11, characterized in that said artificial grass fibres have been obtained from a composite yarn, composed of the polyamide yarn manufactured in accordance with the method as defined in claims 5 - 6, and of the yarn of the block copolymer of polypropylene and polyethylene manufactured in accordance with the method as defined in claims 7 - 8.

13. A field of artificial grass according to claims 10 - 11, characterized in that said artificial grass fibres have been obtained from the polyamide yarn manufactured in accordance with the method as defined in claims 5 - 6, and from the yarn of the block copolymer of polypropylene and polyethylene manufactured in accordance with the method as defined in claims 7 - 8.

14. A field of artificial grass according to claims 10 - 13, characterized in that said field is a field of artificial grass which is scattered in with sand.

INTERNATIONAL SEARCH REPORT

In national Application No

PCT/NL 98/00413

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 D02G3/04 D01F6/46 D01F6/90 D01F8/06 D01F8/12
E01C13/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 D02G D01F E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>DATABASE WPI Section Ch, Week 9517 Derwent Publications Ltd., London, GB; Class A23, AN 95-126442 XP002058435 & JP 07 048778 A (SEKISUI CHEM IND CO LTD) , 21 February 1995 cited in the application see abstract; figures</p>	1,5,7, 10,11,14
X	<p>PATENT ABSTRACTS OF JAPAN vol. 097, no. 009, 30 September 1997 & JP 09 119036 A (HAGIWARA KOGYO KK), 6 May 1997 cited in the application see abstract</p>	1,4,10

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

28 October 1998

Date of mailing of the international search report

05/11/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Tarrida Torrell, J

INTERNATIONAL SEARCH REPORT

Int. l. Application No.

PCT/NL 98/00413

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP 0 648 868 A (DESSEAUX H TAPIJT FAB)</p> <p>19 April 1995</p> <p>cited in the application</p> <p>-----</p>	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 98/00413

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0648868 A	19-04-1995	NL 9301798 A	16-05-1995
		AT 151475 T	15-04-1997
		DE 69402504 D	15-05-1997
		DE 69402504 T	17-07-1997
		DK 648868 T	21-07-1997
		ES 2099534 T	16-05-1997
		JP 7197308 A	01-08-1995
		NZ 264629 A	26-09-1995
